Human Sounds Recognition: On Some Recognizable Acoustic Features of Arabic Pharyngeal [G]

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Abstract

Pharyngeal consonants are generally considered problematic . The phonetic literature so for available reveals different descriptions of these sounds. Correspondingly, the Arabic pharyngeal consonants/G/ and /h vary considerably in their phonetic description from one phonetician to another. Moreover, The aim of this study is to investigative some facts about the phonetic status of the Arabic pharyngeal sounds. In order in do so, the study is restricted to one pharyngeal sound only. Therefore, the domain of the study is specially focused on the Arabic pharyngeal sound /G/ in two different positions. The Arabic pharyngeal consonant /G/ has at least two different allophones both characterized by a vertical articulation. A significant phonetic difference is realized between these two allophones of /G/ .

Introduction:

It does worth to mention the fact that this study is a humble procedural integration for several previous studies made in the late decades made in this area, where Sharpe was unhappy with the attempt to put a defining boarder line between macro and micro phonetic and phonological analyses.

In the middle of the seventies, Knowlsa put much faith in the recognizable acoustic features as micro componential traces that might help to illustrate a better understanding to the analysis any "speech act" which was gaining prestige at that time.

In the eighties Crystle made his advice to follow a clear separation between the acoustic recognizable primary and secondary avidness. A better analytical process that lead to a better understanding to the different readings of the acoustic cues.

Later Akamatso made valuable Pharyngeal consonants are generally considered problematic. The phonetic literature so far available reveals different descriptions of these sounds. Correspondingly, the Arabic pharyngeal consonants /G and / h/(1) very considerably in their phonetic description from one phonetician to another. Moreover, nothing or very little has been written about their allophonic status within meaningful words.

To mention some, Abercrombie (1967) describes them as voiced and voiceless pharyngeal fricatives and nothing is said about their allophones. Gimson (1970) claims that a constriction may be made between the lower rear part of the tongue and the wall of the pharynx only. Similarly, O'Connor

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(1) The symbol / G/ is represented in Arabic orthography by the letter and the symbol /h/ by the letter(ح).

(1973) [1] asserts that the tongue may come so close to the back wall of the Pharynx that the air passing through causes friction[2] and no word about their allophones. Richard Paget (1963) states that these sounds are produced by an obstruction made by the miniature tongue or flap, known as epiglottis. Likewise, Pike (1943) distinguishes between pharyngeal sounds jointly articulated by the root of the tongue and the wall of the pharynx. Pei and Gaynor (1959) describe these sounds as consonants phonated at the pharynx, but they never speak about their allophones[3]
. In generative phonology Chomsky and Halle (1968) describe these sounds as non-anterior and have no idea about their allophonic status [4]

So far, and because of all of these inconsistencies and vagueness in the description of the pharyngeals, some other phoneticians have tried different approaches, but most could neither give a proper description of these sounds, [5]nor acceptable information about their allophonic status.

Consequently, these inconsistent and obscure attitudes toward describing the pharyngeal sounds are regarded as a serious problem which needs to be investigated, studied thoroughly and described objectively. Thus, and in order to do so, the best objective approach recommended here is an instrumental one. A spectrographic study of any of these sounds can be a reliable approach to a certain extent.

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(1) See O'Connor (1973), P, 42, where he asserts the existence of two sounds, one voiced, and one voiceless in Arabic.

(2) See Fant, (1962), P, 3. He calls other sounds fricatives when produced by a very narrow passage of the air-stream in the obstructed region of the mouth or the pharynx.

(3) This statement is adapted from Pei, M.A. and Gaynor F, (1964), P. 166.

(4) Chomsky and Halle state the following description to these pharyngeal sounds Anterior coronal low Back see p. 306.

(5) This statement refers to the works of Helfner (1950), Hockett (1955), Jackobson (1956) and (1962), Perkell (1969), Al-Ani (1970).

Aim and Domain of the Study.

The primary aim of this study is to investigate some facts about the phonetic status of the Arabic pharyngeal sounds. In order to do so, the study is restricted to one pharyngeal sound only. Therefore, the domain of the study is specially focused on the Arabic pharyngeal sound /G/ in two different positions. The allophonic reality of this sound at word-initial position as against word-final position is codified and described as precisely as possible hoping to shed light on the distributional phonetic status of one of the Arabic pharyngeal sounds within its inventory of speech sounds. Thus, meaningful sound units consisting of CVC sequence from the stock of Arabic lexicon are selected as a corpus.

The Data

The pharyngeal consonant /G/ occurs in several Semitic languages. But, the data required for this study is related to the Arabic /G/ sound only. It has been prepared in the phonetic laboratory at Jordan University. The selected samples [(1)]of Arabic lexical items of CVC are written in Arabic to be read by the informants [(2)] for testing their accurate production first, and for the process of recording subsequent to the adjustment of the production time-span so as to bring it within the time-span of the spectrogram.

Table No. I illustrates the samples selected for the purpose of investigation required for the study. The selection of CVC construction is made to restrict the study to a particular situation and to minimize errors.

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(1) These speech sounds are regarded here as a representative sample of Classical Arabic only.

(2) Two different informants are used in the preparation of the spectrographic data. Both are educated Jordanian-Arabic native speakers.

position	SYMBOL	CVC	ARABIC	MEANING
Word INITAL	/G-/	/Gi:d/ /Ga:d/ /Gu:d/	عيد عاد عود	feast seturned stick
Word FINAL	/-G/	/bi:G/ /ba:G/ /bu:G/	بيع باع بوع	sold sold elbow

Table No. 1 THE SELECTED SAMBLES

The Analytical Procedure

The procedure followed in this study as a whole is based on an instrumental approach. The analytical procedure is basically concerned with the identification and specification of the phonetic features of the Arabic pharyngeal sound /G/. The significant acoustic features of /G/ are codified and described as precisely as possible to investigate its phonetic status within two contrasting positions of meaningful Arabic words (1) The analysis is presented first in simple analytical diagrams depicting the acoustic distinctive feature (2) of duration read in milliseconds, intensity read in frequencies of different levels and formant structures read in frequencies of cycles per second. These analytical diagrams are turned into illustrations of sound-feature segments(3) to identify the sounds within the CVC syllable (4) as a single phonetic unit. Finally, some articulatory assumptions of the glottis and the pharynx are made, as accurately as possible, on the basis of

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(1) The exclusion of the sentence here is to avoid overlapping supra-segmental features only.

(2) There are several types of phonetic features bundled altcgether within the spectrum of any given portion of speech sounds. The primary aim of this procedure is to extract the distinctive features of /G/ with the exclusion of expressive and redundant features. For further information see Jakobson and Halle, (1956), pp. 8-37 and Bondarke (1970) pp. 1-40.

(3) This approach is advocated by Fant (1969) in accord with the theory of distinctive features, of Jakobson, Fant and Halle (1962).

(4) The syllable here is equal to a word.

the analytical and illustrative diagrams in order to map up the nature of these sounds based on their acoustic features only. This, as one thinks, might help to a great extent to identify the phonetic contrast of the sound /G/ in two different positions. The resulting differences reached will be regarded as allophonic variants rather than phonemic ones which are objectively considered in this study as the acoustic clues for the final conclusion.

Significance of the Study

The pharyngeal consonant /G/ is one of two different consonants extant within the phonological system of Arabic speech sounds. No matter how much inconsistently these two speech sounds are described within the phonetic literature, /G/ is distinguished by its distinct vertical place of articulation[(1)] , Recently, Al-Ani (1970) has utilized an X-Ray device to investigate its place and manner of articulation. Yet, this device is not as revealing as expected. It is very hard to realize the movements of the pharyngeal organs on an X-ray film, because the film is two-dimensional [(2)] and the anatomical construction of the posterior wall of the pharynx blurs the interior details. That is why AL-Ani mixed it with other laryngeal consonants in an attempt to give a proper phonemic description of it. Unlike most phoneticians, who describe /G/ as a voiced pharyngeal fricative, he asserts after a thorough acoustic analysis that the most common

(1) Peterson and Shoup (1966, pp. 29-30) define the vertical place of articulation as, a set of anatomical location from the place to the glottis.

(2) Al-Ani (1970, p. 59) tried hard to examine the pharyngeal cavity on X-ray films- these films are very clear, but it was very difficult for him to realize the movements of the pharyngeal muscles involved in the articulation of the Arabic pharyngeal consonants.

allophone of /G/ is a voiceless stop and not a voiced fricative.[1]

Consequently, and no matter how much truth is in the above statement another fold is added to the problem of describing the Arabic pharyngeal /G/. AL-Ani adds no further details about the nature of the allophones of the Arabic pharyngeal /G/ [2] . Hence, the call for a further acoustic study [3] of the allophonic statues of the Arabic pharyngeals is rather demanding and worthwhile.

In a new attempt, aside from AL-Ani and several other phoneticians the significance of this study lies in the fact that it utilizes the concept of sound-feature segment as a basic unit for the analysis. Thus, a syllable or a word can be analyzed into a sequence of sound segments [4] . The acoustic boundaries of these sound segments are definable in the light of either specific articulator events or the corresponding time selective-changes in the spectral composition of the speech act [5] . The acoustic boundaries of a speech-segment are thus associated with changes in the manner of articulation, e.g voiced/ voiceless, fricative /non-fricative, nasal/non-nasal, etc, whereas, the place of articulation determines acoustic patterns that vary more or less continuously within and across the speech-segment boundaries.

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(1) Ibid, (p: 60) AL-Ani has followed a pure phonemic analysis depending largely on the existence of the phoneme as a phonetic unit.

(2) Ibid, (pp. 5-14).

(3) The speech feature segment will be regarded here as a basic phonetic unit. A speech sound can be one speech feature segment or more. This is the main difference between this study and that of AL-Ani.

(4) This point of view is adopted with some modification from Fant (1962) as against the concept of indivisible phoneme.

(5) Ibid, (pp. 15-16) this statement is adopted here to be utilized for the following acoustic analysis.

Acoustic Features of the Speech Samples

The analysis and codification of the important acoustic information relevant to this type of study reveal the following readings shown within Table 2 and 3.

ACOUSTIC FEATURES							
SAMPLES	Silence	Burst	Voiced Noise	Periodic Voice	Burst	Silence	TOTAL
عيد /Gi:d/	50	40	110	510	80	60	840
/Ga:d/ عاد	40	30	60	570	60	40	810
عود /Gu:d/	40	60	120	490	90	30	830
AVERANGE	43.3	43.3	96.3	523.3	76.6	43.3	826.6

Table (2) Acoustic Features of /G/ in CVC Sequence of Word-initial Position, /G-/.

ACOUSTIC FEATURES							
SAMPLES	Silence	Burst	Periodic Voice	Voiced Noise	Burst	Silence	TOTAL
بيع /bi:G/	50	20	390	130	40	70	750
باع /ba:G/	20	80	460	90	40	60	750
بوع /bu:G/	70	90	360	130	30	40	720
AVE RANGE	46.6	63.3	403.3	113.3	36.6	56.6	740

Table (3) Acoustic Features of /G/ in CVC Sequence of Word-final Position, /-G/.

Discussion:

In order to investigate the phonetic nature of the allophones of the Arabic pharyngeal consonant /G/ within CVC sequence, it is believed that this sequence is made up out of a bundle of sound-feature segments. In general the bundle of /G/ at word-initial position, characterized on basis of the average (Table 2), is assumed to be as follows:

i- 43.3 ms, silence =>complete closure in the pharynx + no vibration of the vocal cords + devoicing.

ii- 43.3 ms, burst => plosion resulting from the release of the closure + vibration of the vocal cords.

iii- 96.3 ms, voiced Noise => narrowing in the pharynx causing local friction + vibration of the vocal cords + correlation with the following segment.

iv- 523.3 ms, periodic voice =>opening of a vocalic segment.

v- 76.6 ms, burst => Plosion resulting from /d/ + vibration of the vocal cords.

vi- 43.3 ms, silence => devoicing of /d/ at the end.

Whereas, the bundle of /G/ at word-final positions, characterized on the basis of the average, (Table 3), is assumed to be as follows:

i- 46.6 ms. silence => closure of /b/ + no vibration of the vocal cords + devoicing.

ii- 63.3 ms. burst => Plosion of /b/ + vibration of the vocal cords.

iii- 403.3 ms. Periodic voice => opening of a vocalic segment + vibration of the vocal cords+ correlation with the following segment.

iv- 113.3 ms. voiced noise => narrowing in the pharynx + vibration of the vocal cords.

v- 36.6 ms. burst => plosion resulting from the release of the closure + vibration of the vocal-cords.

vi- 56.6 ms. silence => devoicing of /G/ at the end.

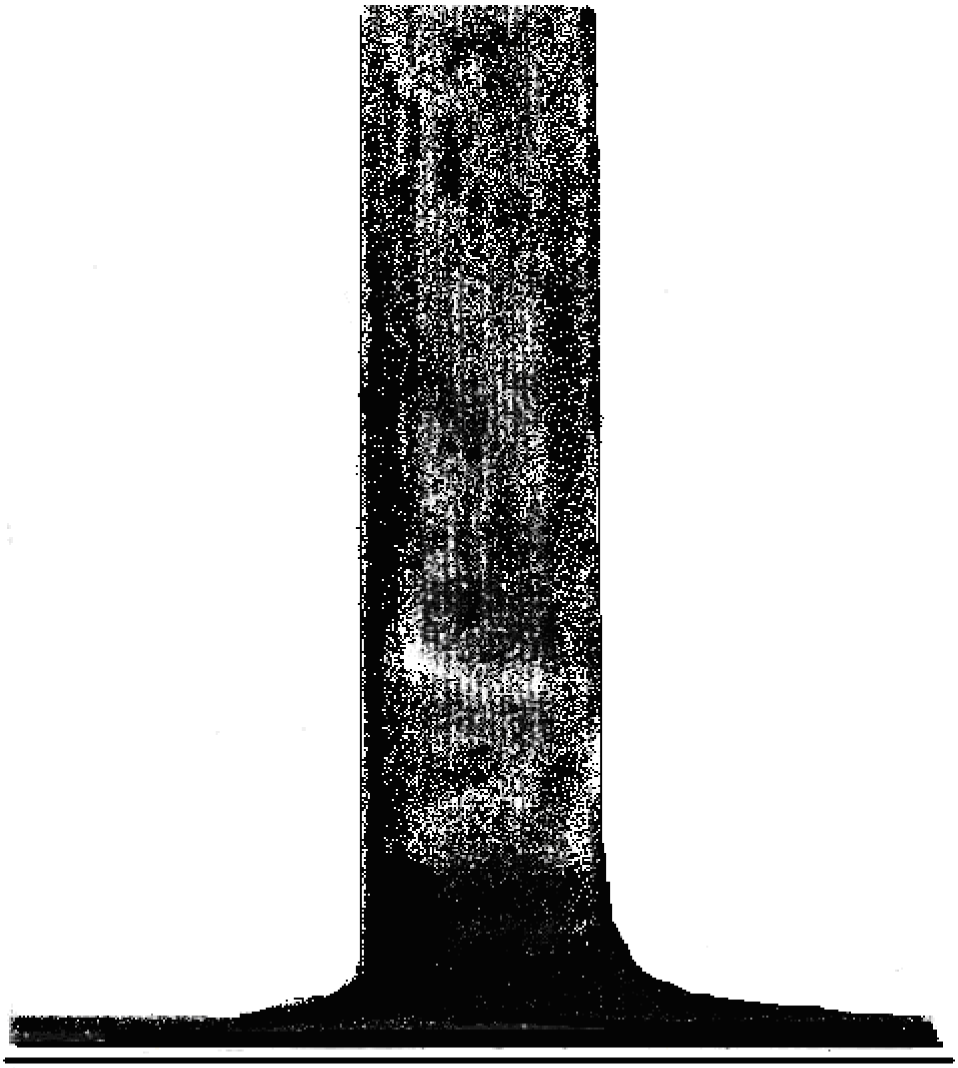
From the above discussion, and as far as the Arabic pharyngeal /G/ is concerned, a significant phonetic difference is realized apart from the slight difference in the measurements of the duration of initial /G/ and that of final /G/. In the former, the burst segment of 43.3 ms, in average, is followed by voiced noise of about 96.6 ms, resulting from the correlation of the local friction (noise) with the periodic voice of the vowel element. Whereas in the latter, the burst feature of about 36.6 ms. is realized after the voiced noise of 113.3 ms in average. Correspondingly, one can assume that two different allophones of /G/ exist in Arabic. The initial /G/ is phonetically different from the final one. An articulatory assumption shown on different parameters might reveal some facts about their articulatory status within the selected samples.

Parametric Articulator Assumptions

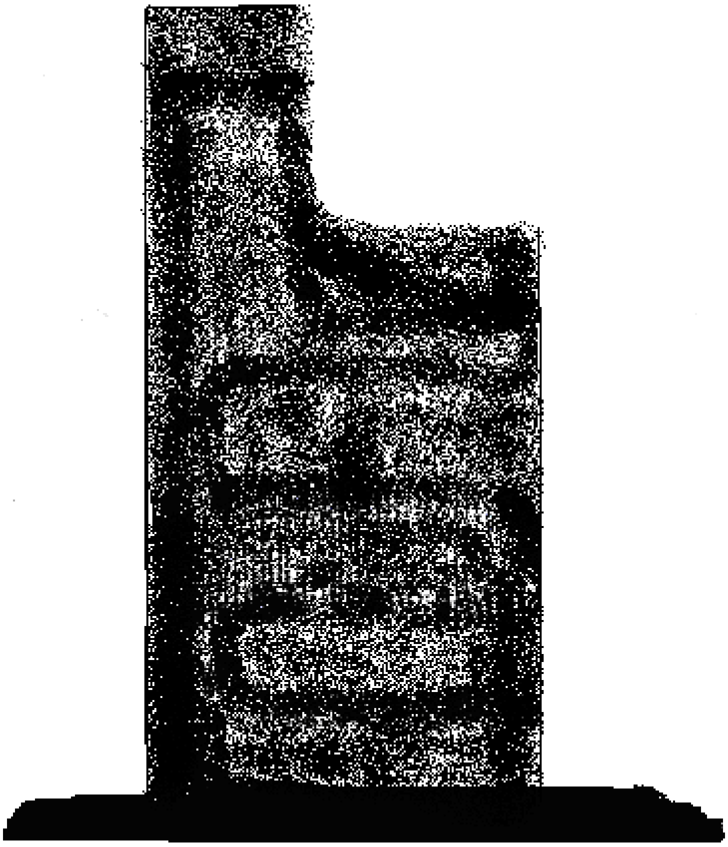
The following parametric diagrams (A) and (B) are carefully mapped out to illustrate some articulatory assumptions based on the above findings. The bundles of the acoustic-feature segments are synchronized in time with the articulatory assumptions of the pharynx and the state of the vocal cords within different parameters. These diagrams will help shed light on the articulatory status of an initial /G-/ as well as a final one /-G/. The different is regarded as a clue supporting a final statement about the nature of the Arabic pharyngeal /G/. (see diagram /G-/)

Conclusion

From all above acoustic findings, it is evident now that the Arabic pharyngeal consonant /G/ has at least two different allophones both characterized by a vertical articulation. A significant phonetic difference is realized between these two allophones of /G/. Apart from the slight differences in measurements of duration, an initial Arabic /G/ has an affricate-like articulation shown in the construction of a burst followed by voiced noise. Whereas, an Arabic final /G/ seems to have the reverse articulation of an affricate which is realized in the construction of a voiced noise followed by a burst. Although these two allophones occur in complementary distribution the contrast between their structures of the sound-feature segments reveals some facts about the phonetic status of the two variants. A final Arabic /G/ is almost a mirror-image of an initial one (Diagrams A, B, & C illustrate this fact). Moreover, this study will keep the door open for investigations of the phonetic nature of the Arabic pharyngeal /G/ within similar or larger units of others phonetic environments such as word-medial, inter-vocalic and within consonant clusters.

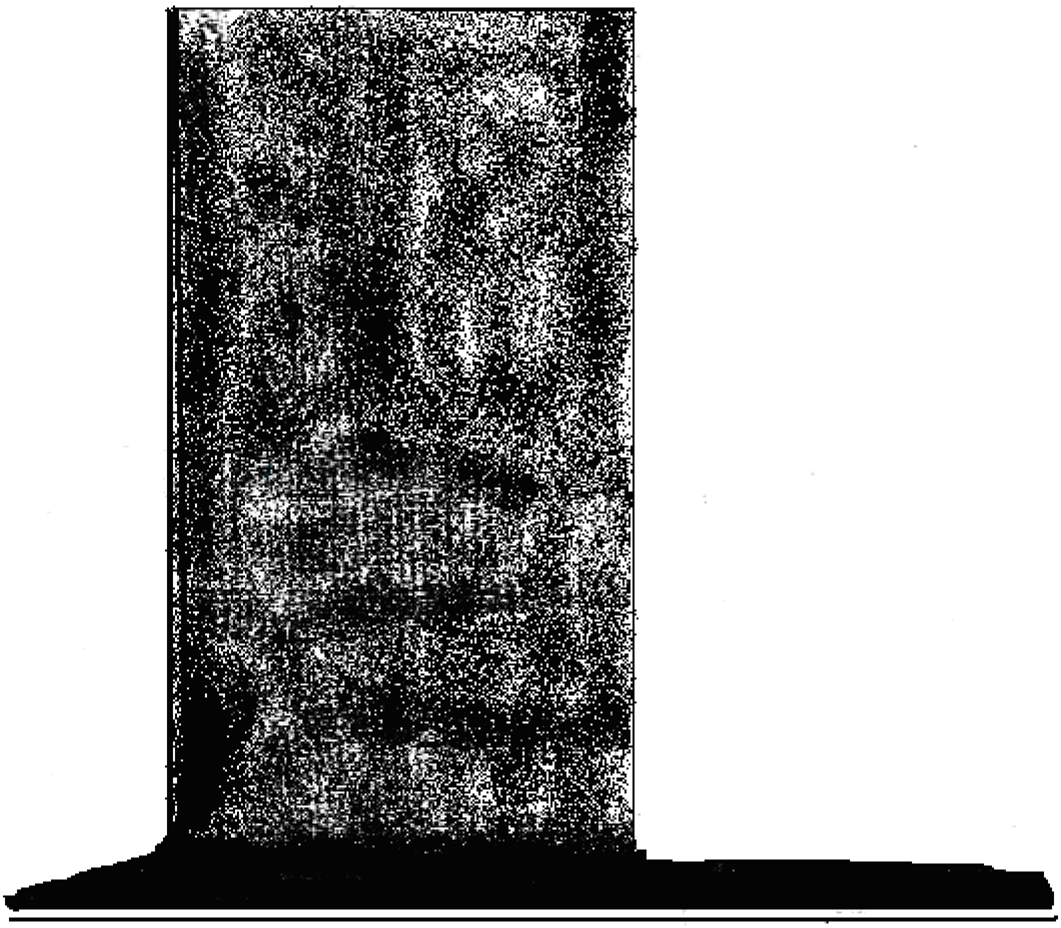


THE SPECTRUM OF / ba : Ɋ /

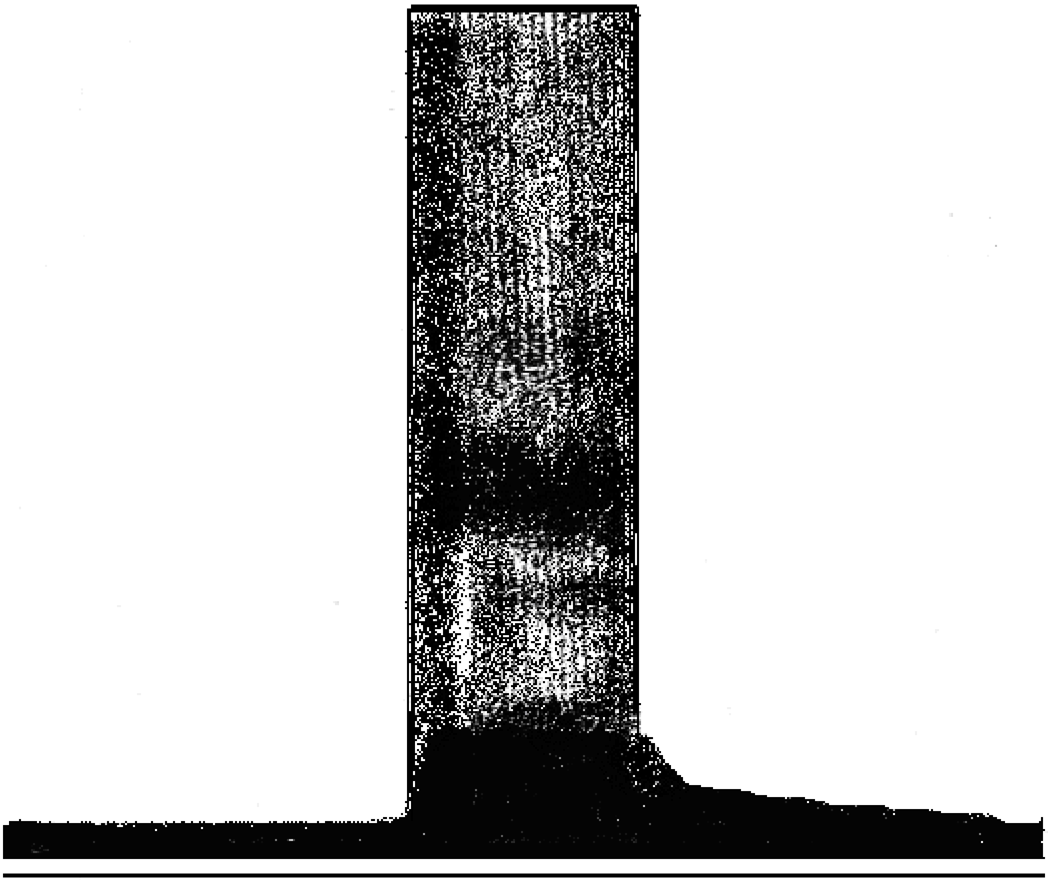


/ b i : Ģ /

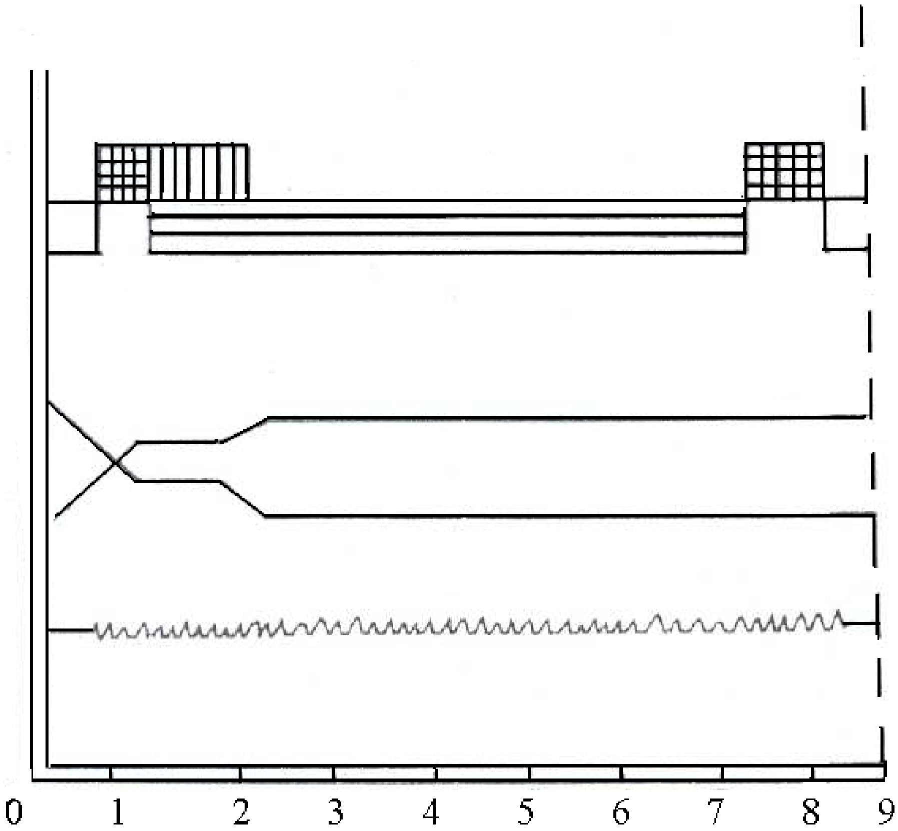
THE SPECTRUM OF / bi : Ģ / بيع



THE SPECTRUM OF / Ɋi : d / عيد

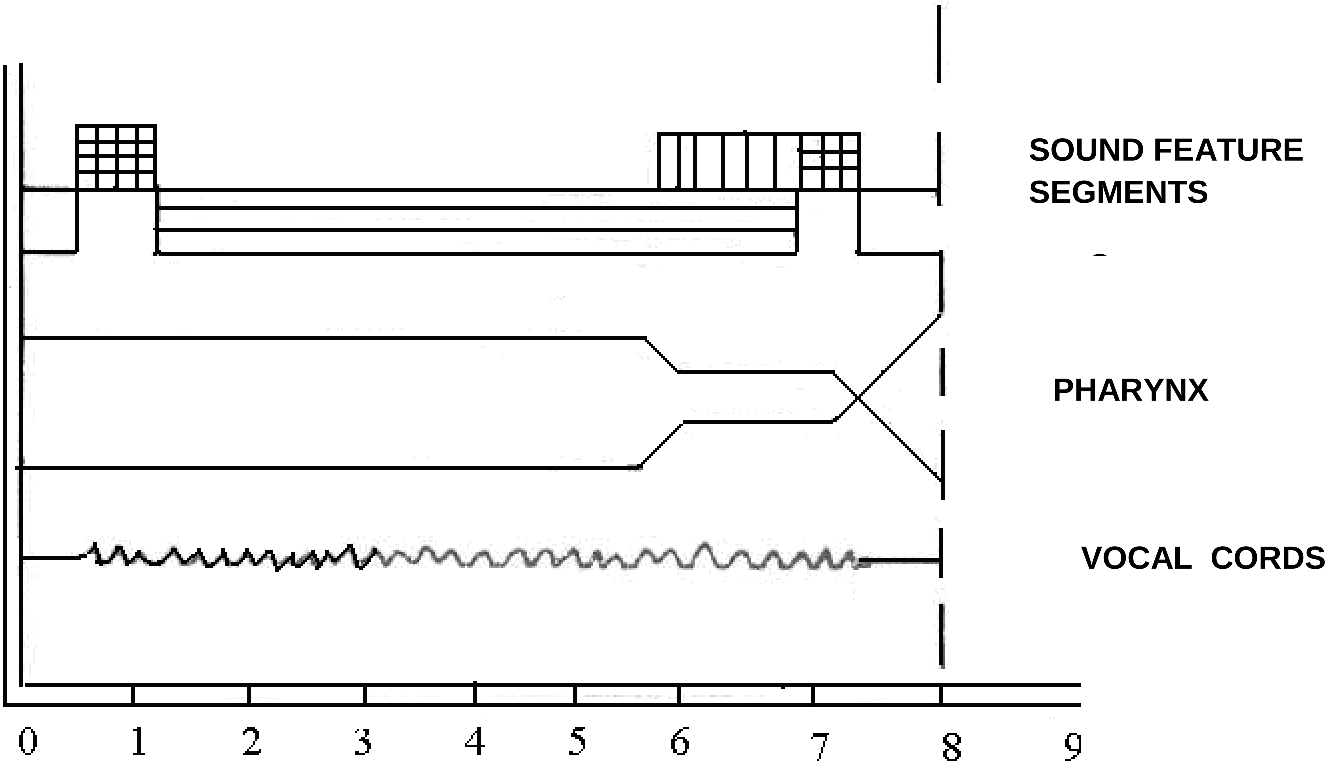


THE SPECTRUM OF / Ga : d / عاد

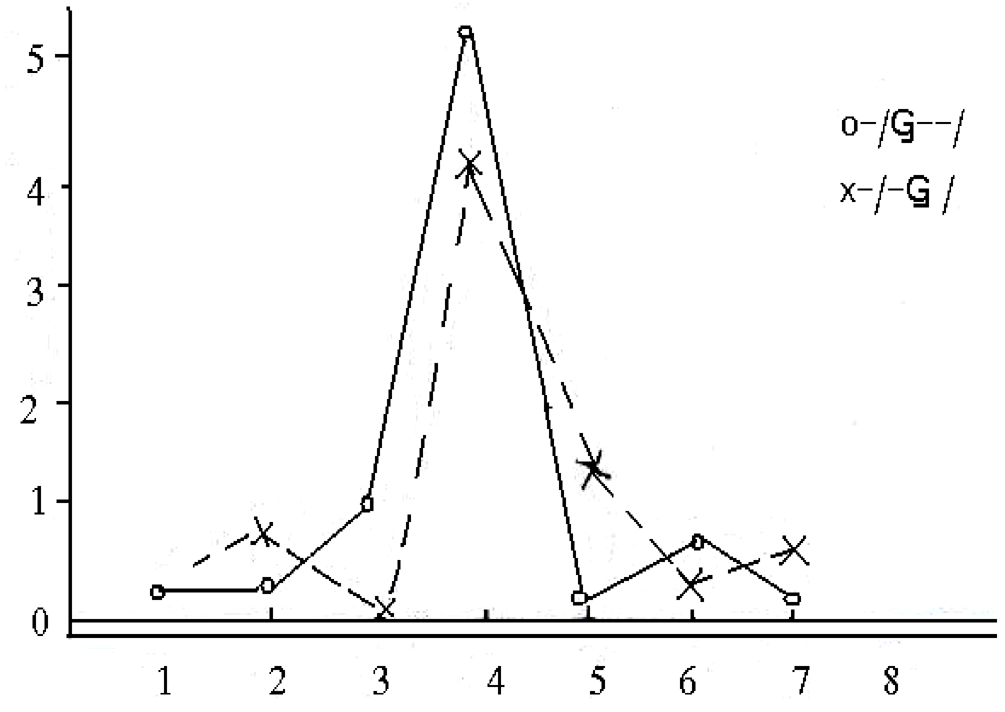


DAIGRAM_ A

Acoustic analysis and parametric illustrations of the Arabic / Ģ/ at word _initial position ,The average measurement.

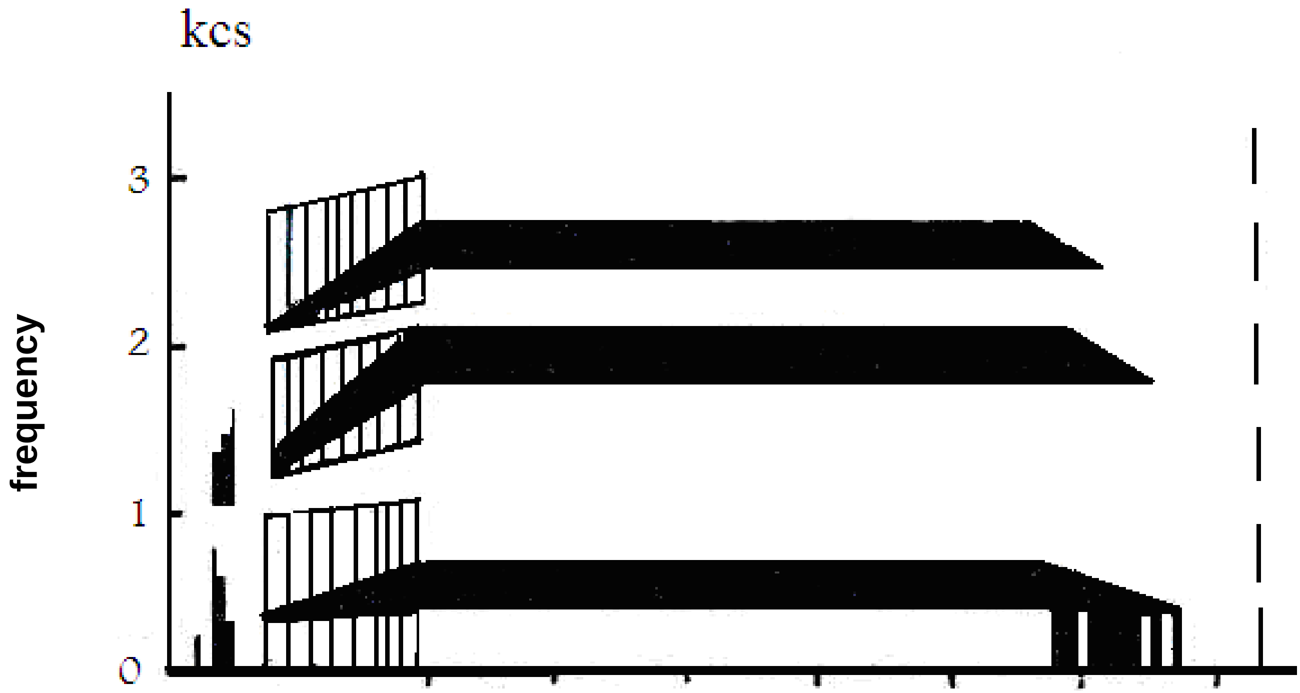


DAIGRAM_ B
Acoustic analysis and parametric illustrations of the Arabic /-Ģ / at word _initial position ,The average measurement.

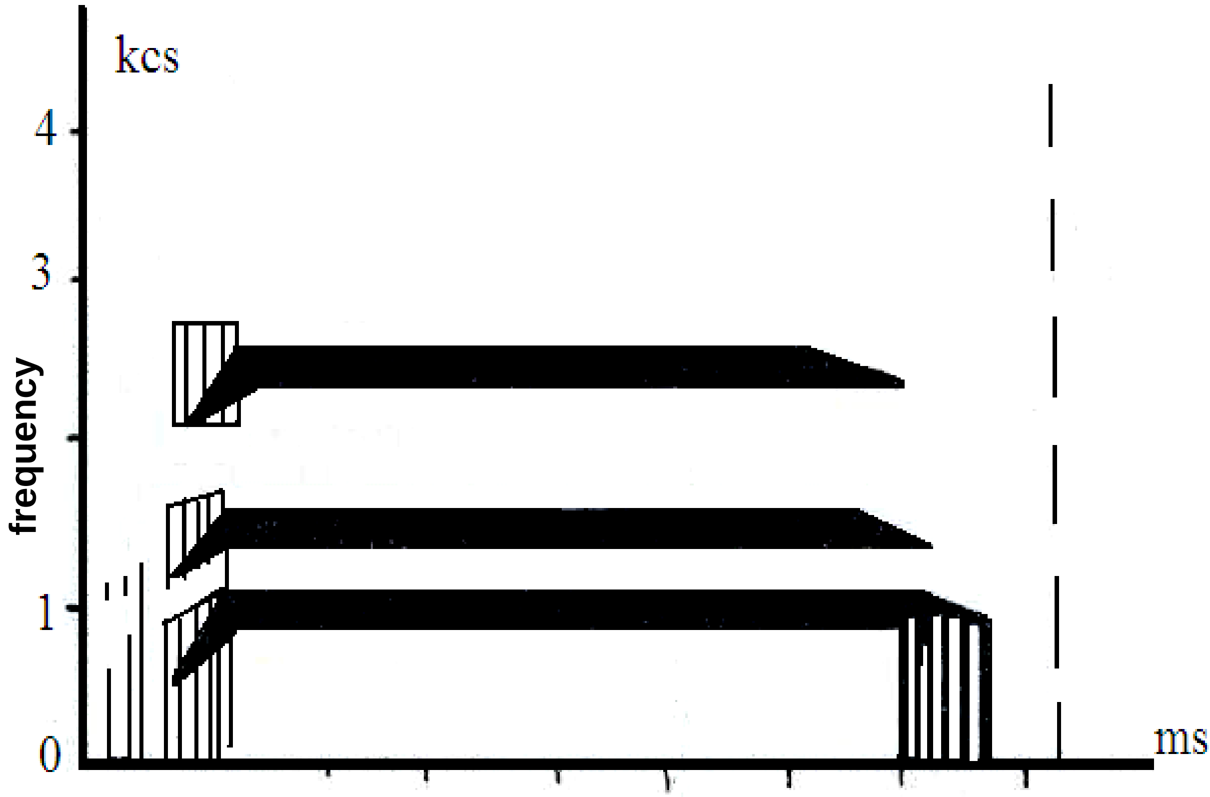


DAIGRAM_ C

The contrast between / Ģ-/ and / - Ģ/



ACOUSTIC FEATURES OF THE WORD
/ Ģ /: d / عيد



ACOUSTIC FEATURES OF THE WORD /Ģ aid عاد

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